

APG system of Plant Classification



APG system of classification

APG

A for Angiosperm

P for Phylogeny

G for Group

A collaborative effort by a group of botanists and plant systematists

Published a classification of 462 families of Angiosperms in 1998

1. This system of plant classification was modern classification system for Flowering plants (Angiosperms)
2. It was developed based on,
 - Molecular and Morphological data, focusing on Evolutionary relationships (Phylogenetic Approach)
 - Grouping of plants into Monophyletic clades (shared common ancestors)
 - No strict hierarchy (Ex. No subclasses, superorders) used
 - The use of informal names (Ex. Core eudicots) was included

Why was this system of classification developed?

- ✓ Traditional systems relied on the morphological aspects for classification which led to artificial grouping
- ✓ APG system was developed to reflect the evolutionary relationships based on molecular and genetic data

Criteria considered for grouping,

- Cladistic analysis of DNA sequences of three genes, two chloroplast genes and one gene coding for ribosomes
- Molecular evidences
- Pollen morphology (supported the split between the Eudicots and the rest of the former Dicotyledons)

Members of first APG

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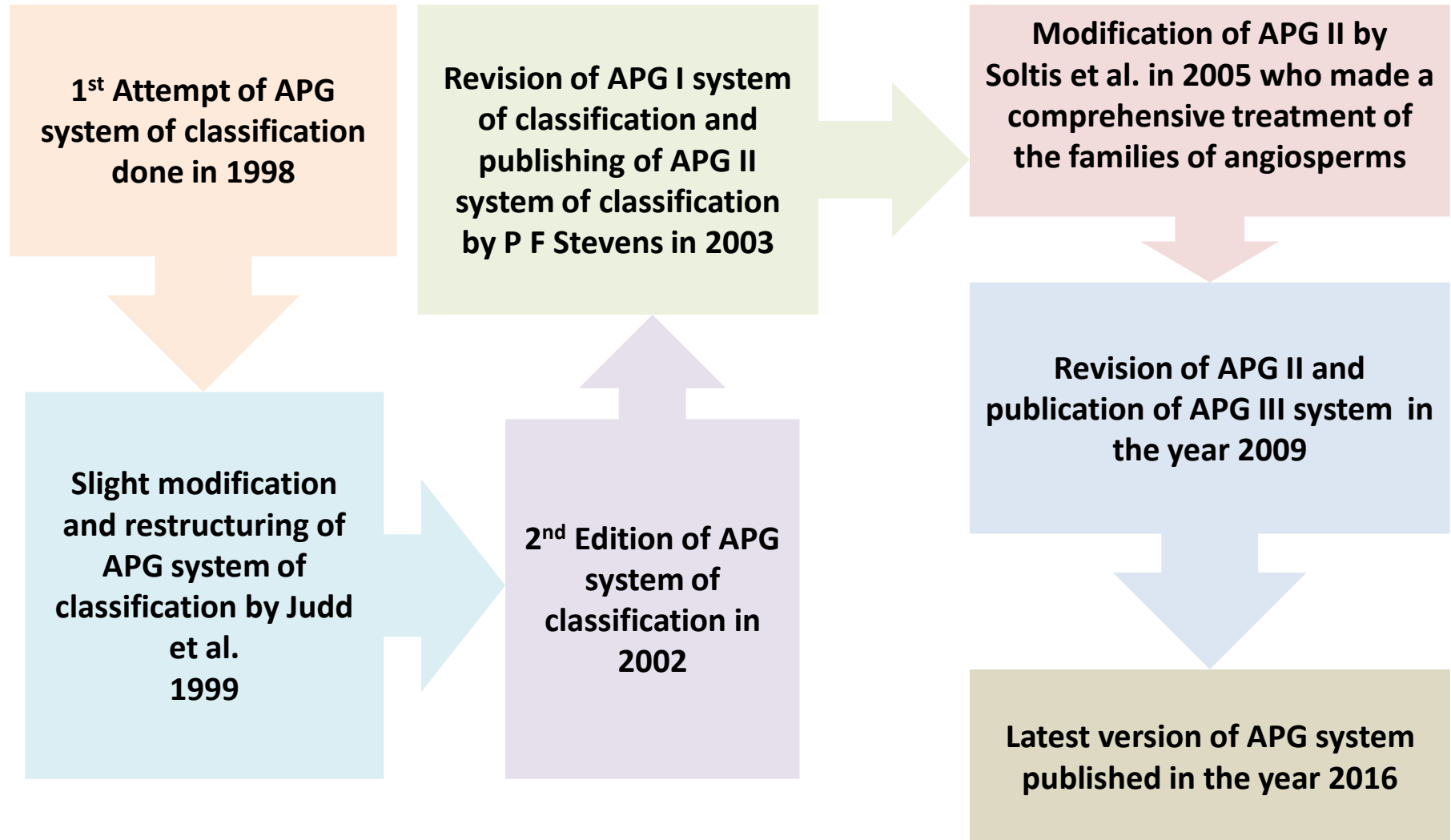


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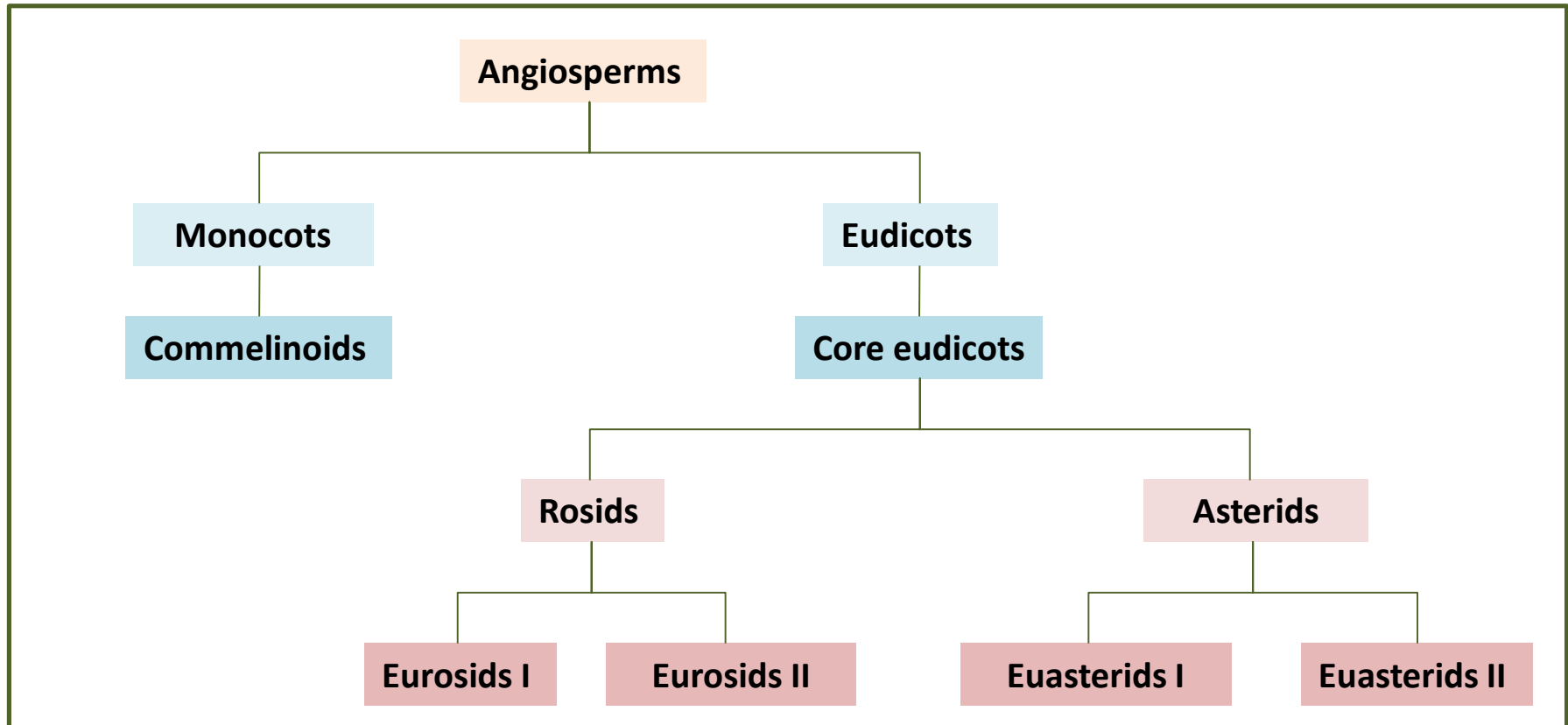
Roadmap of APG system

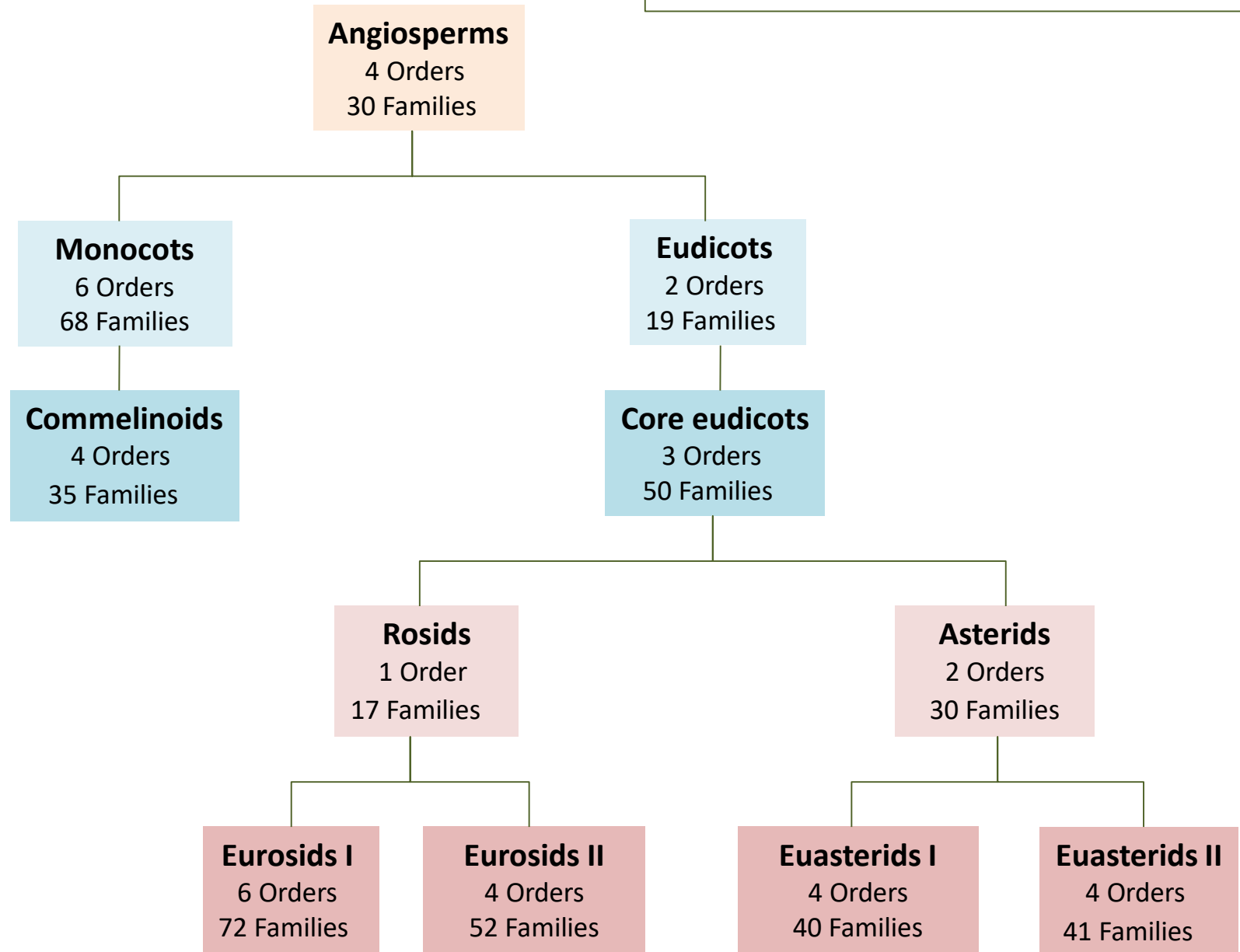


APG I SYSTEM OF CLASSIFICATION (1998)

- 1st attempt to group and classify angiosperms on Molecular basis
- Published in the year 1998
- Grouping of plants by evolutionary relationships (clades)
- It focused on monophyletic groups (group of plants which are from single common ancestor)

Outline of classification:



APG I SYSTEM OF CLASSIFICATION (1998)

Key features:

- **462 families** were grouped into **40 putative Monophyletic orders** under a small number of informal monophyletic higher groups:
 - **Monocots**
 - **Commelinoids**
 - **Eudicots**
 - **Core Eudicots**
 - **Rosids**
 - **Eurosids I**
 - **Eurosids II**
 - **Asterids**
 - **Euasterids I**
 - **Euasterids II**
- An additional list of **25 families** of uncertain position for which no firm data existed regarding placement anywhere within the system was made

Limitations of APG I system of classification:

- X Its focus on **higher taxonomic levels** like orders, led to many unplaced families
- X An **unresolved higher-level consensus tree**
- X Use of **preliminary “bracketed” system** for some families which was confusing and subsequently abandoned
- X The 1998 paper was a starting point based on the genetic data available at that time and the **genetic data was limited**
- X Certain groups, especially **parasitic plants, were difficult to place** accurately because their genetic material had diverged significantly
- X **82 unplaced families** of which 12 were placed towards the beginning and 25 towards the end and 45 unplaced in the informal ten groups
- X In addition, **18 families classified** in four orders, placed in the beginning did not have any taxon at supraordinal rank

Modifications of APG classification were presented by Judd et al. (1999)

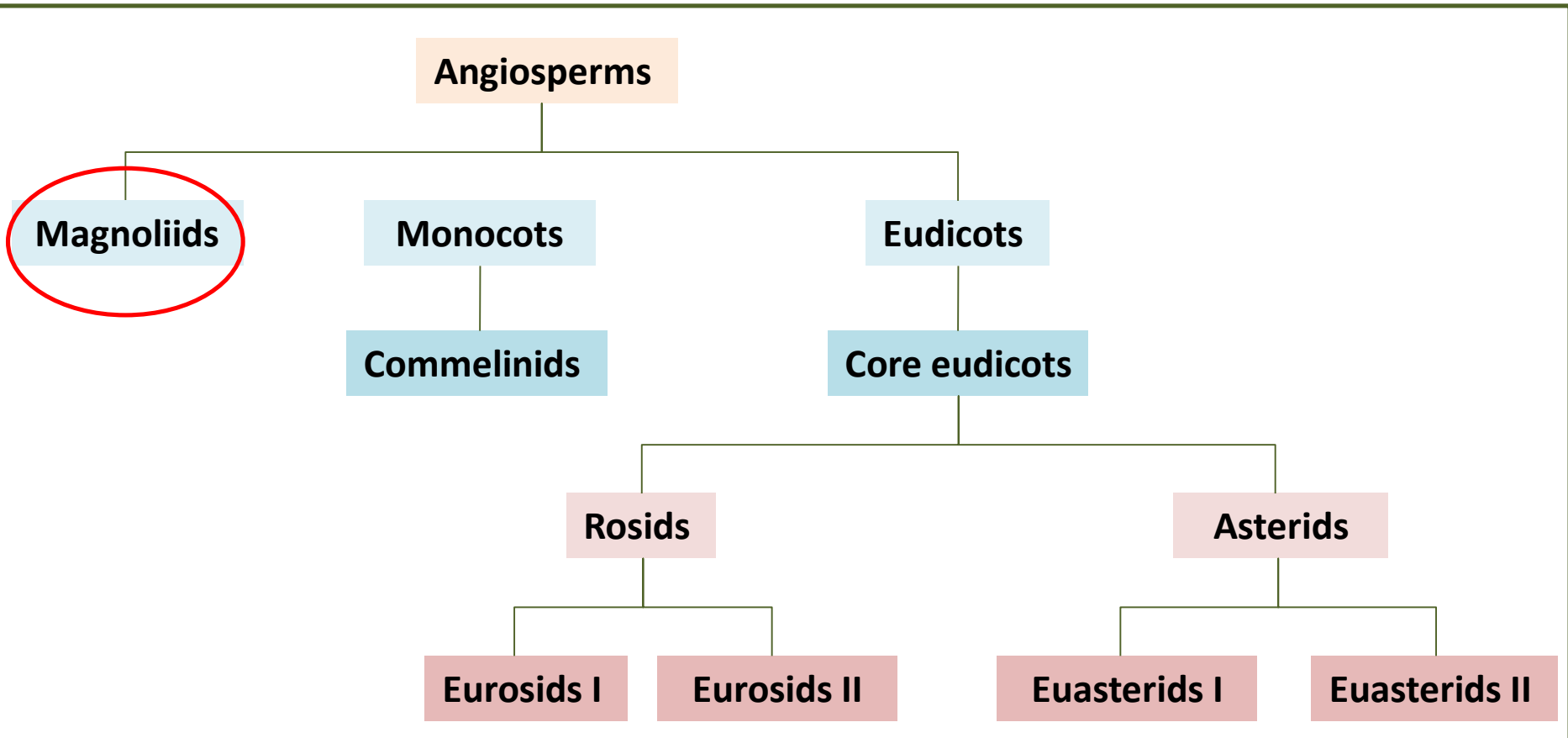
- Recognized a total of **51 orders** and shifting some families from informal groups where they were directly placed in 1998 classification, to these orders
- The book listed only major families and as such nearly **200 families** have been left out

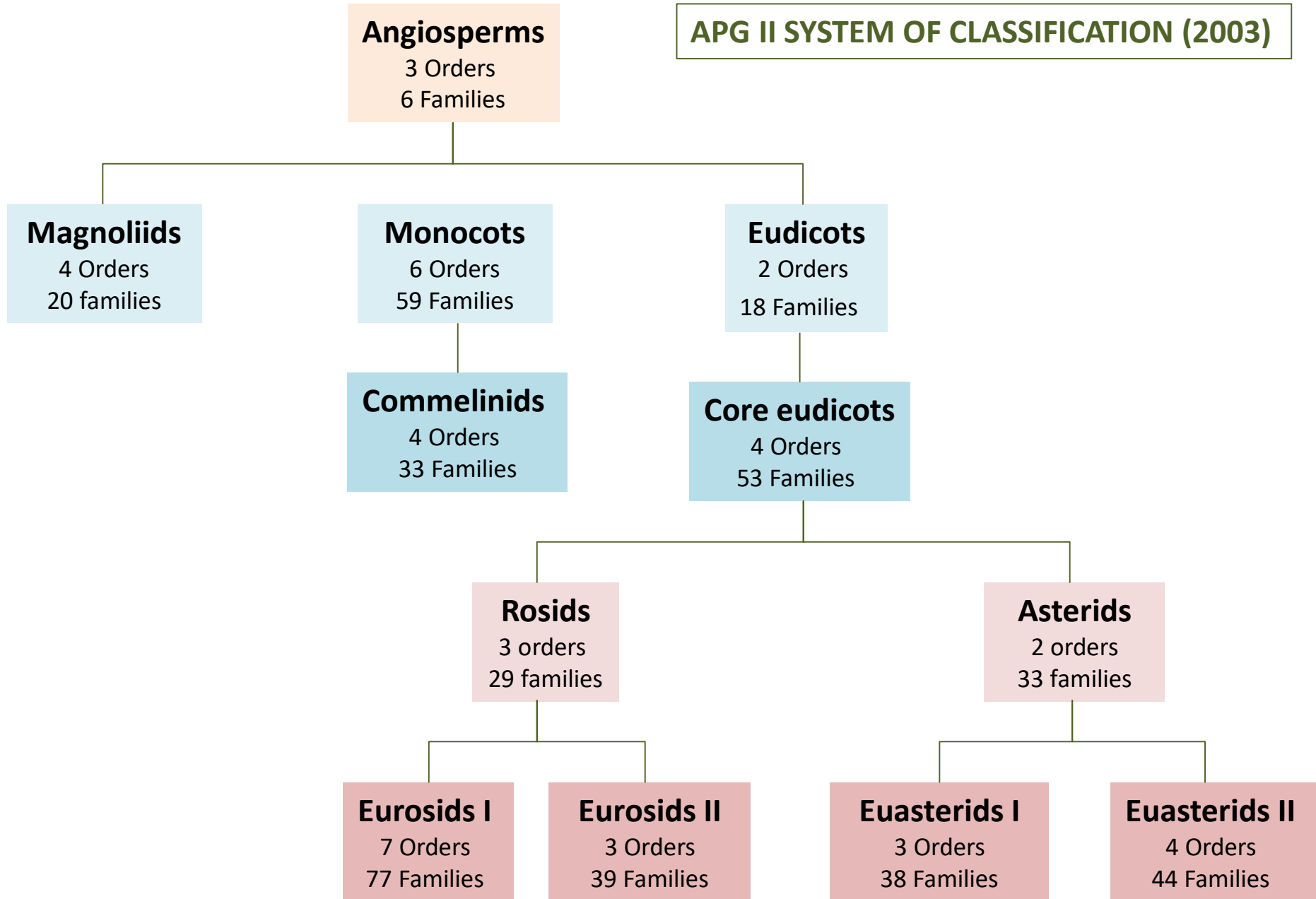
A revision presented in the **2nd edition** (2002) has further improvements in line with the thinking of APG, and is largely similar to the APG II classification with minor differences

- The **revision of APG (APG, 2003)** and continuous upgradation **on Angiosperm Phylogeny website** by **P F Stevens** have resulted in considerable refinement in the APG scheme, with more and more families (and some orders) coming out of the list on unplaced taxa
- The **APG II classification** recognized,
 - **45 orders** of Angiosperms, of which 44 are placed in 11 informal groups, considered more or less monophyletic
 - One order is unassigned at the beginning of Angiosperms
 - A total of **457 families** are recognized

APG II SYSTEM OF CLASSIFICATION (2003)

- 2nd APG classification system
- Published in the year 2003
- Contributors: Birgitta Bremer, Kare Bremer, Mark W Chase, James L Reveal Douglas E Soltis, Pamela S Soltis, Peter F Stevens
- Based on molecular evidences
- It was the revision of the first APG system (1998)

Outline of classification:

APG II SYSTEM OF CLASSIFICATION (2003)

Key features:

- Recognized **45 orders**, (5 more than the older version of APG system)
- New orders were,
 - **Austrobaileyales**
 - **Canellales**
 - **Gunnerales**
 - **Celastrales**
 - **Crossosomatales** all of which were families unplaced as to order, although contained in supraordinal clades in the APG system (1998)
- It recognized **457 families**, (5 fewer than APG (1998))
- 39 of APG families were not placed in any order, but **36** of the 39 were placed in a supra-ordinal Clade within the angiosperms
- **55 of the families** came to known as “**Bracketed families**”

Limitations of APG II:

- ✗ The bracketed families caused confusions because it presented a choice between a single large family or multiple smaller ones (Ex. The broad **Asparagaceae** with 7 potential bracketed families)
- ✗ Some families were remained unplaced with certainty due to conflicting evidences, leading the number of unresolved families within the system
- ✗ The grouping was done based on artificial characters with the result, that closely allied families are placed widely apart
- ✗ Some advanced families (**Orchidaceae** and **Scitamineae**) were treated at the beginning of monocots

Modification of APG II (After 2003)

- Steven updated **APweb** (version 7, June 2008)
- Reduced the number of **unplaced families to 7**
- Added **4 orders of gymnosperms** in APweb
- Recognized **16 additional orders of angiosperms** (total **61**) of which **3 accommodate unplaced families** of APG II in the beginning of angiosperms, **1 in monocots, 2 in Commelinoids, 2 in Eudicots, 3 in core Eudicots, 1 in Eurosids**

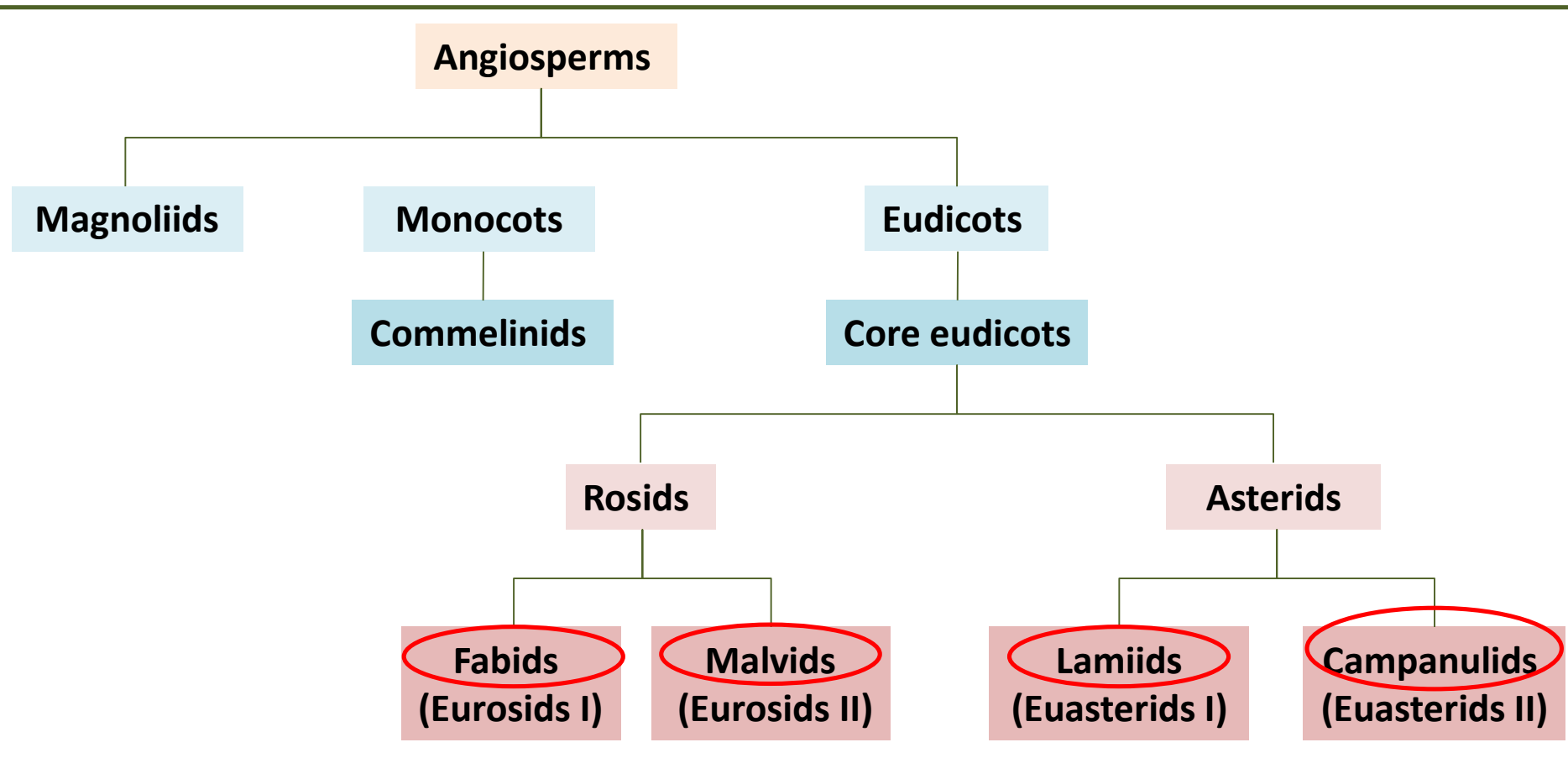
Modification of APG II (2005) led to APG III

- **Soltis et al.** made a comprehensive treatment of the families of angiosperms
- The number of unplaced families reduced to **26** and **3 orders** (Petrosaviales, Dasypogonales, Berberidopsidales) were added to the APG scheme and one dropped (Ceratophyllales) thus recognizing a total of **47 orders**

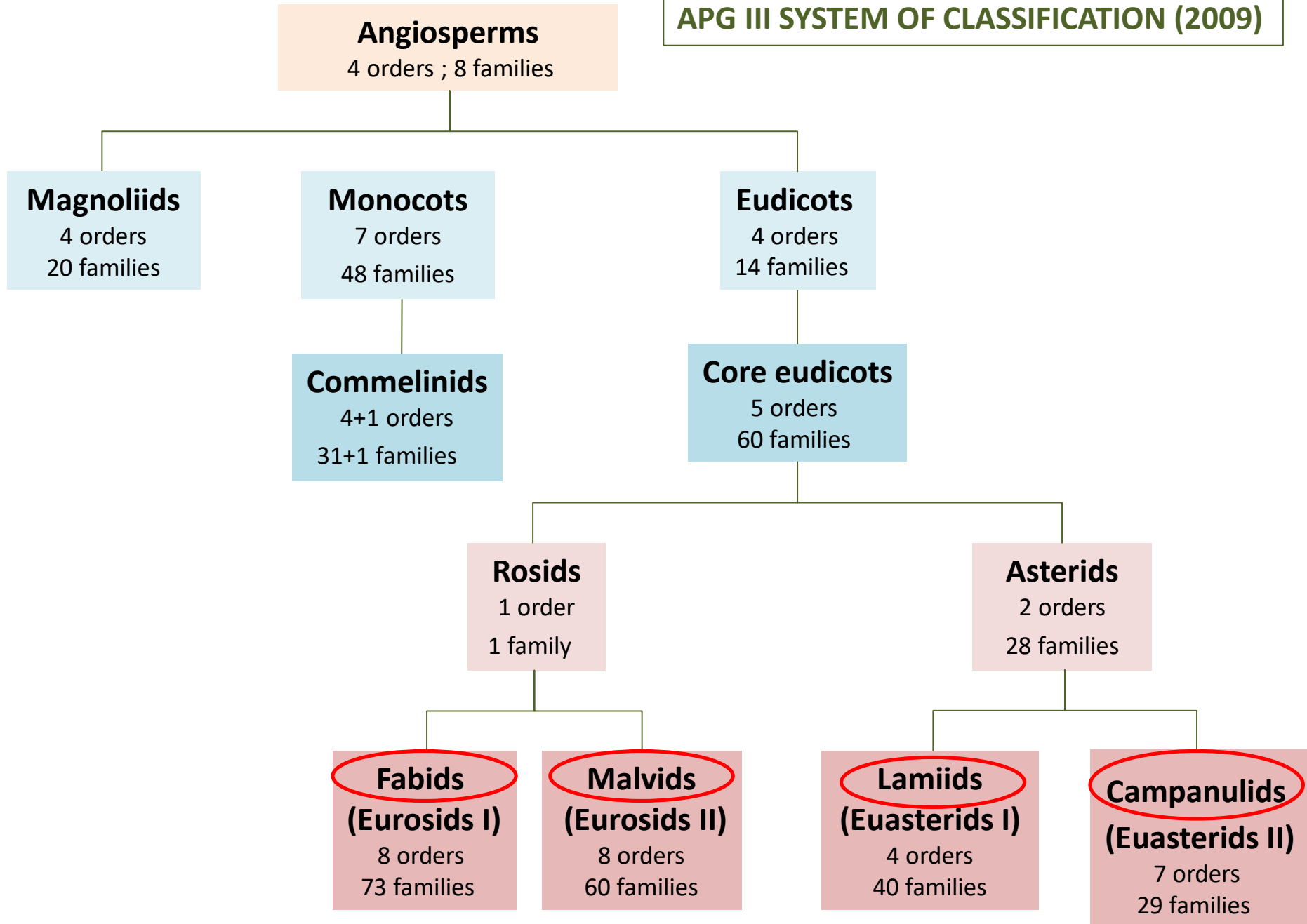
APG III SYSTEM OF CLASSIFICATION (2009)

- 3rd version of modern system of plant taxonomy
- Contributors: Mark W Chase, Michael F Fay, James L reveal, Douglas E Soltis, Pamela S Soltis, Peter F Stevens
- Published in the year 2009
- This system was meant to fit the system into the existing Linnean hierarchy
- This system was based on a phylogenetic tree for the angiosperms which included all of the 59 orders and 4 of the unplaced families

Outline of classification:



APG III SYSTEM OF CLASSIFICATION (2009)



Key features:

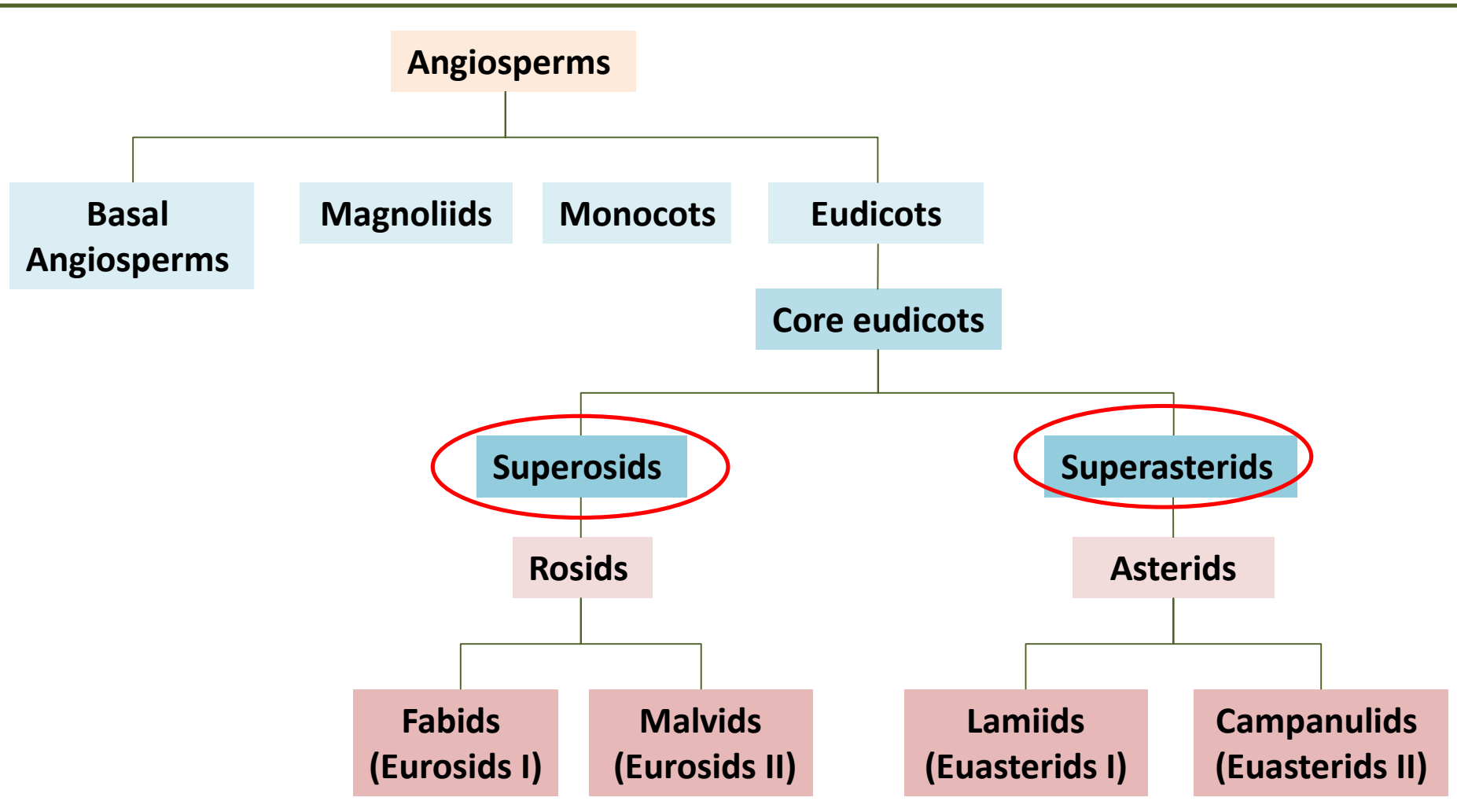
- This system recognized **413 families**, 43 fewer than the previous system, 44 of 55 “bracketed families” were discontinued, 20 other families were discontinued as well
- **21 families** were accepted which had not been in the previous system, few families were moved to a different position
- The number of families not placed in any order was reduced from 39 to 10
- This system recognized all of the **45 orders** of the previous system as well as **14 new ones**
- The order Ceratophyllales was erroneously marked as a new order
- The newly recognized orders are- Amborellales, Nymphaeales, Chloranthales, Petrosaviales, Trochodendrales, Buxales, Vitales, Zygophyllales, Picramniales, Huerteales, Berberidopsidales, Escalloniales, Bruniales and Paracryphiales
- The “**bracketed families**” were abandoned

Limitations of APG III:

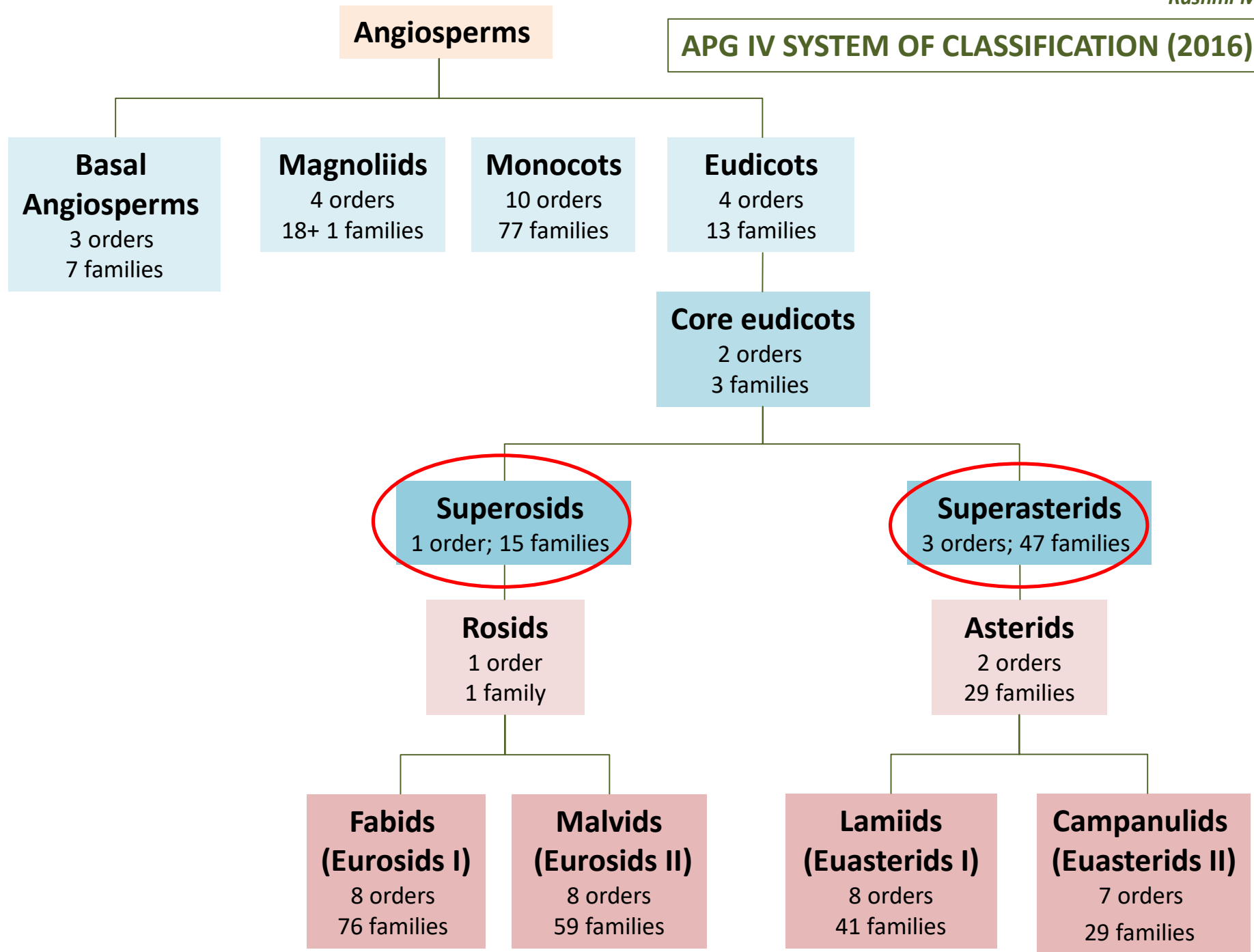
- X The phylogenetic relationships were unresolved
- X This system **did not considered the comprehensive classification of all lower taxonomic levels** like genera or species as it only focused on orders and families
- X Several families and genera were not given place within the APG III framework
- X The **use of informal grouping** like Eudicots and Magnoliids which are not formal taxonomic ranks are quite confusing and also do not follow the official rules of Botanical nomenclature (ICBN)
- X The “**lumping**” approach, i.e., merging of families resulted in loss of details for those who prefer a more split classification

- 4th version of a modern, molecular based system of plant taxonomy
- It was published in 2016
- It recognizes 5 new orders (Boraginales, Dilleniales, Icaciniales, Mettenuisales and Vahliales) along with some new families, making the total of 64 angiosperm orders and 416 families

Outline of classification:



APG IV SYSTEM OF CLASSIFICATION (2016)



Key features:

- This system recognized **64 orders, 416 families**
- It divided the angiosperms into Early/ Basal Angiosperms, Monocots, Eudicots (Core angiosperms)
- **5 new orders** were included
- Many families like, Asclepiadaceae merged to Apocynaceae; Bombacaceae, Sterculiaceae, Tiliaceae merged to Malvaceae; Chenopodiaceae included in Amaranthaceae
- There were **no “Bracketed families”** included
- The system is built with updated new data ensuring it remains current with advances in molecular biology and phylogenetics
- It included **2 additional informal major clades**, Superosids and Superasterids which group additional orders within the broader Rosids and Asterids clades
- The system also incorporates the **“Linear approach” (LAPG)** which presents the classification in a linear order

Limitations of APG IV:

- ✗ This system of classification has prioritized the higher taxonomic levels and provided less details for lower ranks
- ✗ Some families, groups were not placed in the APG framework
- ✗ The system relies heavily on molecular data, which can be a limitation when molecular data is incomplete
- ✗ For some of the group there are no sufficient fossil and other data available which can create challenge to place them

Important points:

	APG I	APG II	APG III	APG IV
Year of publication	1998	2003	2009	2016
Families recognized	462	457 (among them 55 are Bracketed families)	413	416
Number of unplaced families	40	39	10	10
Total orders	40	45	45+ 14 new orders	64

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